United States
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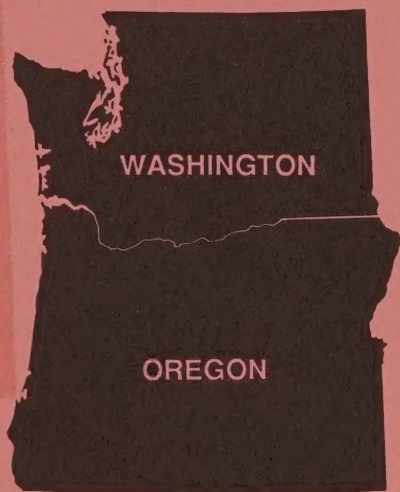
Forest Service

**Pacific
Northwest
Region**

Forest Pest Management

Project Report



1992 UMATILLA AND WALLOWA-WHITMAN

NATIONAL FORESTS

WESTERN SPRUCE BUDWORM

SUPPRESSION PROJECT

WALLOWA VALLEY RANGER DISTRICT

1992 UMATILLA & WALLOWA-WHITMAN NATIONAL FORESTS

WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT

WALLOWA VALLEY RANGER DISTRICT

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1992 UMATILLA AND WALLOWA-WHITMAN NATIONAL FORESTS WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT

WALLOWA VALLEY RANGER DISTRICT

INTRODUCTION

Western spruce budworm (*Choristoneura occidentalis* Freeman) populations have been at outbreak levels on portions of the Umatilla and Wallowa-Whitman National Forests in northeast Oregon since the early 1980's. Defoliation caused by spruce budworm outbreaks, in combination with several other insect pests, severe drought conditions, and other stress factors, has resulted in serious forest health decline over hundreds of thousands of acres in the Blue Mountains of northeast Oregon and southeast Washington.

In 1990 and 1991, both the Umatilla and Wallowa-Whitman National Forests established budworm analysis units to assess the outbreaks and their effects on resource values. Biological evaluations of budworm infestations within analysis units completed during the summer of 1991 revealed population densities high enough to cause moderate to severe defoliation in 1992 (Scott, D.W., 1991 Biological evaluation of western spruce budworm in 1992 analysis units on the Umatilla and Wallowa-Whitman National Forests. Rep. BMZ-91-04, USDA Forest Service. Wallowa-Whitman NF. LaGrande, OR. 54p.).

The two National Forests prepared a site-specific Environmental Assessment, "Umatilla and Wallowa Whitman National Forests Western Spruce Budworm". The alternative selected by the Forest Supervisors was to suppress budworm populations on 185,373 acres in seven analysis units with the biological insecticide *Bacillus thuringiensis* variety *kurstaki* (Btk). A Decision Notice and Finding of No Significant Impact was signed by Forest Supervisors from both National Forests on December 3, 1991.

A decision was made to divide the areas to be sprayed into two separately administered projects because of the distance separating the treatment areas. One project included analysis units on the LaGrande and Walla Walla Ranger Districts while the other project included analysis units on the Wallowa Valley Ranger District. This report describes the objective, location, organization, procedures, and results of the project completed on the *Wallowa Valley District*. A separate report describes the LaGrande project.

OBJECTIVE

The objective of this suppression project was to safely, efficiently, and economically reduce western spruce budworm populations within treatment areas to levels that would not cause additional, unacceptable resource damage for several years. The suppression target goal for each analysis unit was to reduce the budworm population by 90 percent, unadjusted for natural mortality, in the time period from pre- to postspray sampling.

PROJECT AREA

The suppression project was conducted in mixed conifer stands with large proportions of western spruce budworm host species on the Wallowa Valley Ranger District. The project was separated into two analysis units for entomological sampling and analysis purposes. The general vicinity map (Figure 1) shows the location of the analysis units. The following paragraphs describe the general location and characteristics of the analysis units:

> *Kuhn-Chesnimnus*: This analysis unit is located approximately 15 miles north of Enterprise, Oregon. A total of 43,054 treatable acres were contained in this anlysis unit. Of that total, 40,110 acres were on National Forest System lands and 2,944 acres were in non-federal ownership. State Highway 3 bisects the analysis unit in a north-south direction and the Sled Springs Work Center is located at its approximate center. The analysis unit is bordered by Wildcat Creek on the west and Elk Creek on the east.
>
> *Morgan Butte*: This analysis unit is located approximately 20 miles southeast of Joseph, Oregon. A total of 26,521 treatable acres were contained in this analysis unit. Of that total, 25,580 acres were on National Forest System lands and 941 acres were in non-federal ownership. The entire anaysis unit lies to the east of the Wallowa Mountain Loop Road. Harl Butte is located at the extreme northeast corner and Nesbitt Butte is located at southern most tip of the analysis unit. The southern boundary of the analysis unit is generally the boundary between the Wallowa Valley Ranger District and the Hells Canyon National Recreation Area.

Terrain within the project area is highly varied ranging from from large, relatively flat plateaus to very steep slopes and narrow canyons. Elevation ranges from 3,600 to 6,100 feet above sea level.

PROJECT ORGANIZATION

An Incident Command System organization, modified to fit the needs of a forest defoliator suppression project, was used to manage the project. The organization used is displayed in Figure 2. A total of 33 USDA Forest Service, Oregon Department of Forestry, and Bureau of Land Management personnel worked on the project in either full or part time positions. Resource orders for project staff were issued by the Wallowa-Whitman National Forest Dispatch Office through the Northwest Coordination Center. The aerial application contractor had a staff of 20 people on-site.

CONTRACTING

Altair Incorporated of Swanton, Vermont was the primary aerial application contractor. Several subcontractors provided equipment and personnel.

The Forest Service used a Request for Proposals (RFP) to solicit, negotiate, and award the contract. Items contracted for were application aircraft and support equipment and personnel, a sufficient amount of insecticide to treat 69,000 acres, marking of spray block boundaries, application of insecticide, and observation helicopters and pilots certified to transport government employees.

In the RFP, the Forest Service specified that any of three commercially available Btk formulations could be used on the project. These three products were Thuricide 48LV, Foray 48B, and Dipel 6AF. All application was to be done at the rate of 1/2 gallon of undiluted insecticide per acre. This equated to 24 billion international units (BIU) of active ingredient per acre.

Four aerial application contractors responded to the RFP with technical and price proposals. Altair, Incorporated was awarded the contract for the project based on the strength of its technical approach and price. The price for application was $13.97 per acre.

Altair agreed to provide 2 Air Tractor 502 and 1 Air Tractor 402 spray airplanes, 2 Bell 47 Soloy helicopters and 1 Bell UH1-B helicopter for aerial application. The observation helicopter fleet consisted of 2 Bell 206 BIII Jet Rangers and 1 Aerospatiale A-Star.

Altair sprayed Thuricide 48LV supplied by Sandoz Crop Protection Corporation of Chicago, Illinois.

FACILITIES AND EQUIPMENT

The Forest Service established an administrative office and technical center at the Wallowa Mountains Office and Visitor Center warehouse in Enterprise, Oregon.

Supplies and equipment needed for the project were resource ordered from the Forest Pest Management suppression cache at Redmond and the National Fire Equipment System caches at LaGrande and Redmond. Other incidental supplies were purchased locally. A project communications system was ordered from the Boise Interagency Fire Center (BIFC). It was installed and maintained by BIFC and Wallowa-Whitman NF radio technicians.

Altair established staging areas at Joseph Airport, Sled Springs Guard Station (Kuhn-Chesnimnus Analysis Unit), and Nesbitt Butte (Morgan Butte Analysis Unit). The Joseph Airport site was used to stage fixed-wing aircraft throughout the project. The other sites were used to stage rotorcraft while working on each particular analysis unit. A number of other remote loading/fueling sites were used during the project.

SPRAY OPERATIONS

Spray blocks were designated by the Forest Service as helicopter treatment only or treatment allowed by either helicopter or single engine fixed-wing aircraft. The basis for aircraft assignment was safety, probability of successful treatment, and size and shape of spray blocks. Altair was responsible for assigning specific aircraft to specific spray blocks.

Spray blocks were marked prior to spraying by placing bright orange and white streamers in snags and tall trees along the boundaries. This was done by contractor personnel tossing markers from helicopters. Ground panels and distinctive ground features were also used as aides in marking block boundaries.

All spray aircraft were calibrated and characterized at the Joseph Airport. A SwathKit was used to measure and analyze spray patterns created during the characterization spray runs. The Bell 47 Soloys were calibrated for a swath width of 90 feet and a flow rate of 6.1 gallons per minute with an application speed of 65 miles per hour. Volume Median Diameter for spray droplet patterns from the Bell 47 Soloys ranged between 98 and 237 microns for both aircraft. The Bell 47 Soloys were each fitted with 6 Micronair AU-5000 rotary atomizers. The UH1-B was calibrated for a swath width of 130 feet and a flow rate of 9.2 gallons per minute with an application speed of 75 miles per hour. Volume Median Diameter for spray droplet patterns from the UH1-B ranged from 95 to 245 microns. This aircraft was fitted with 8 Beecomist 360 rotary atomizers. The two Air Tractor 502's were each fitted with 8 Micronair AU-5000 rotary atomizers. They were calibrated for a swath width of 150 feet and a flow rate of 23.5 gallons per minute. Volume Median Diameter for spray droplet patterns for the Air Tractor 502's ranged between 127 and 225 microns. The Air Tractor 402 was also fitted with 8 Micronair AU-5000 rotary atomizers. It was calibrated for a swath width of 150 feet and a flow rate of 21.9 gallons per minute. Volume Median Diameter for spray droplet patterns for this aircraft ranged between 174 and 277 microns. All application aircraft were equipped with Crophawk flow meters.

Thuricide 48LV was delivered to the contractor in bulk tanker shipments. No dye was added to the insecticide except during characterization runs. Insecticide was metered by the contractor and monitored by the Forest Service when it was pumped from storage tanks or batch trucks into the application aircraft. The contractor was paid on the basis of gallons of insecticide pumped into the application aircraft and then properly applied.

Application pilots, observation pilots, and Forest Service aerial observers flew over the spray blocks prior to their scheduled treatment to familiarize themselves with block boundaries and determine spray strategies.

The application aircraft flew in teams of three and two, as well as solo, and were accompanied by a single observation helicopter. Spraying was allowed only when observation helicopters were present. Spray and observation aircraft, ground equipment, and support personnel were formed into teams that operated together throughout most of the project. The spray airplanes operated exclusively from the Joseph Airport. The spray helicopters operated from a number of temporary helispots located throughout the project area.

The following weather parameters had to be met before spraying could proceed:

- wind speed between 1 and 8 mph.
- relative humidity greater than 55 percent.
- air temperature between 33 and 70 degrees F.
- spray settling into tree canopy within two minutes.
- no water dripping from foliage.
- no rain predicted within 6 hours of spray application.

Ground-based weather and spray observers monitored weather conditions within spray blocks the morning they were scheduled for treatment. Wind speed and direction, air temperature, and relative humidity were measured with field weather kits, data recorded, and information radioed to the project dispatch office and to the aerial observers. In addition, weather conditions were monitored from 2 Remote Area Weather Stations in close proximity to the project area. Spot forecasts were obtained from the National Weather Service office in Pendleton, Oregon.

Weather and spray observers placed white Kromekote cards in lines in some spray blocks to monitor spray deposition. An attempt was made to place card lines at least one full tree height away from trees. The number cards in each card line varied from 4 to 20.

All cards were laid on the ground in plastic holders. Spray drops falling within two 1 square centimeter fields predrawn on the cards were counted by project personnel using dissecting microscopes.

Spray blocks were to be treated within 72 hours of being released or they were temporarily removed from the spray schedule in order to do another prespray sample. In the course of the project, several spray blocks were sampled prior to treatment more than once.

A daily shift plan was jointly developed by the Forest Service and the contractor which documented the aircraft, personnel, radio frequencies, and spray blocks assigned to each spray team. Treatment priorities were assigned to blocks when there was more than one block to spray. A daily safety plan was attached to the shift plan.

Pilots and aerial observers reviewed their assignments each morning at a daily briefing held in the contractor's office in Joseph. This meeting took place at 0330 each day. Flight following of each aircraft was done constantly at 15 minute intervals by the project dispatcher.

ENTOMOLGY OPERATIONS

Entomology operations in the Kuhn and Morgan Analysis Units adhered closely to the objectives and procedures set forth in the 1992 project entomology work plan. The only change involved a modification of criteria used in timing of block releases. This became necessary because the development of budworm larvae and their host trees was different from that which was expected from previous years' observations.

The entomology staff consisted of one project entomologist, two biological field crew leaders, and one biological aide, all of whom worked individually in the field. Each of these individuals had worked on at least two previous insect suppression projects. Two persons from the Oregon Department of Forestry, who worked primarily as weather and spray observers, also assisted the regular entomology staff when needed.

The task of installing budworm density sample plots in the two Analysis Units was begun on May 6th and completed by June 1st. Plot sites were selected using criteria described in the project entomology work plan. A total of 34 plots was installed in each of the two Analysis Units.

At the same time that the density plots were being installed, the phenological development of budworm larvae and of host tree buds and shoots was being monitored to determine proper timing of treatment. This involved systematic visual examinations of foliage throughout the Analysis Units to determine stages of the budworm larvae and the extent of shoot elongation.

Early monitoring revealed that seasonal phenology of both the budworm and its hosts was atypical from that of previous seasons. The proportion of both early and late instars feeding concurrently during the later period of the larval stage was greater than expected i.e., when later instars were abundant, the numbers of 2nd and 3rd instars was disproportionately high. In addition, bud expansion and shoot elongation of host species lagged behind larval development more than would normally be expected, based on previous seasons' observations.

The two release criteria in the 1992 project entomology work plan were based upon biological information from previous seasons. The first of these criteria specified that a spray block was ready for treatment when the first 6th instar was observed in the block. For this project, it was stipulated further that before blocks were released less than 15% 2nd and 3rd instars be present in any given foliar examination. Foliar examinations involved visually estimating instar distribution. The second criterion requiring 95% shoot elongation of host trees as originally specified in the entomology work plan was strictly adhered to.

The first blocks requiring treatment were released in the Kuhn Analysis Unit June 4th. Block release in the Morgan Unit began on June 12th.

Pre-treatment samples were taken at plots in a block within 24 hours prior to its treatment. When a block was not treated within 72 hours following its release, its plots were resampled. This was necessary on ten plots in the Kuhn Unit when adverse weather conditions interrupted the spraying schedule. Heavy rains did not permit resampling on 5 plots in the Morgan Unit before spraying was resumed.

Pre-treatment sampling was completed in the Kuhn Unit on June 13th and in the Morgan Unit, on June 18th.

Additional pre-treatment sampling was conducted on 24 of the 34 plots in the Morgan Unit to determine what proportion of budworm larvae remained on sample branches after they were beaten. Sampling these "clinging larvae" consisted of visually examining foliage on each sample branch after it had been beaten. The numbers of residual budworms thus found were recorded by instar, and the data analysed separately from the lower crown beating data.

Post-treatment sampling in both Analysis Units proceeded on schedule, each plot being sampled at the start of pupation but no less than 14 days and no more than 21 days after treatment. Post-treatment sampling began June 12th and was completed July 6th.

All of the pre- and post-treatment data were entered into computer data files and summarized. In summarizing the data, the WESTBUDS program converted the lower crown data to their mid crown equivalents, which has been the standard unit for reporting density data on prior budworm suppression projects. Data on budworm exuviae were not included in the larval analyses because the current year's cast skins could not be distinguished from those of previous seasons.

SPRAY OPERATIONS ACCOMPLISHMENTS

Analysis unit treatment data are displayed in Appendix Table 1. A total of 70,222 acres were sprayed. Insecticide application began on June 5 and was completed on June 22. Four days were not suitable for spraying because of fog or rain. Low relative humidity limited the amount of time available for spraying on several mornings.

The three fixed-wing aircraft sprayed 42,066 acres. They averaged 760 acres per hour per aircraft. The two Bell 47 Soloys sprayed 11,322 acres and averaged 208 acres per hour per aircraft. The UH1-B sprayed 16,834 acres and averaged 741 acres per hour.

A total of 291.5 flight hours were recorded on the project. This included 11.4 hours of recon time, 5.2 hours of administrative flight time, 43.3 hours for boundary marking, 93.7 hours of inspection time, and 137.9 hours of actual spray time.

Seventy two card lines, with a total of 665 spray deposit cards were placed in 60 spray blocks. Spray drops were seen on 94 percent of the cards and droplet density averaged 17 droplets per square centimeter. The percentage of cards with measured spray deposit was slightly higher in the in spray blocks sprayed by fixed wing aircraft than in those sprayed by helicopter. The average spray droplet density was greatest in blocks sprayed with fixed wing aircraft.

No problems were encountered while handling the insecticide.

ENTOMOLOGY SAMPLING RESULTS

The analyses of pre- and post-treatment data for both the Kuhn and Morgan Units are summarized in Table 2 (see appendix). Pre-treatment budworm densities averaged 9.7 and 7.6 larvae per 45 cm. mid crown branch in the Kuhn and Morgan Analysis Units, respectively. Post-treatment densities averaged 1.3 and 0.8 larvae per 45 cm. mid crown branch in the Kuhn and Morgan Analysis Units, respectively. Graphic displays of pre- and post-treatment data for both units are shown by the histograms in figures 1 and 2 (see appendix).

These larval density figures indicate that budworm populations were reduced by 87% and 90% on the Kuhn and Morgan Units, respectively. These reductions were the result of both the insecticidal effects and natural mortality factors.

The data from the Morgan plots comparing the numbers of larvae collected from lower crown beating with numbers left on sample branches after beating were analysed separately from the pre-treatment data. On 24 plots sampled, the average number of larvae per 45 cm. mid crown branch collected by the standard branch beating method was 7.9. The average number of residual larvae left clinging to the sample branches after they were beaten was 1.7. These figures indicate that 17.7% of the total number of larvae present on the sample branches remained on the foliage after the branches were beaten. Combining the two sets of data revealed that the mean instar in the lower crown at the time of sampling was 5.0.

BUDGET

Total project cost was $1,162,817. Cost per sprayed acre averaged $16.56. A breakdown of costs is shown in Table 3. The contract accounted for $13.97 per acre with administrative costs being $2.59 per acre. All costs of spraying National Forest System lands were paid by the Federal government. Cost of spraying 3,885 acres of non-federal lands were shared with the owners. Individuals or businesses owning less than 500 treatable acres paid 50 percent of the cost. Those with more than 500 treatable acres paid 66 percent of the cost. State agencies paid 75 percent of the cost of treating their lands.

SAFETY

There were no reportable accidents, injuries, or spills on the project. Driving on rough, unimproved forest roads in the dark was one of the most hazardous activities on the project. Approximately 48,000 miles were driven by project personnel.

A primary reason for the excellent safety record was the active involvement of the project safety officer during all activities. The project had an excellent safety plan. Daily safety messages were posted and each group held daily tailgate safety meetings.

DISCUSSION

The short term goal of achieving a 90 percent population reduction, unadjusted for natural mortality, was met on the Morgan analysis unit but not on the Kuhn-Chesnimnus analysis unit, using the converted mid-crown branch budworm densities as the comparison measure. The populations declined by a low of 87 percent on the Kuhn-Chesnimnus analysis unit to a high of 90 percent on the Morgan analysis unit. The population reduction measured is a result of a combination of insecticidal effects and natural mortality. No attempts were made to quantify the contributions of various mortality components.

The postspray population density is a better indication of short-term project success than percent population decline. Recent western spruce budworm suppression projects done by the Forest Service in Oregon and Washington have had a goal of reducing the budworm population to 1 or fewer larva and/or pupa per 18 inch midcrown branch in the posrspray analysis unit samples. This target was not used for this project. The Morgan analysis unit has a postspray density of 0.8 and the Kuhn-Chesnimnus analysis unit had a density of 1.3. We believe that the populations in th sprayed areas have declined to levels where defoliation will be reduced for the next 1 to 3 years from densities seen in 1991. This, in turn, may provide some degree of short-term recovery for defoliated trees. Unless actions are taken to reduce susceptibility of stands to budworm outbreaks, such as reducing the proportion of budworm host species, there is a high likelihood the spray areas will be subject to budworm outbreaks within a few years.

The Incident Command organization and approach used to manage the project was efficient and effective. Steps should be taken to include large insect suppression projects within the National Interagency Incident Management System.

The negotiated contract process worked well and resulted in obtaining the services of a firm with several years experience spraying Pacific Northwest and other forested areas with high quality equipment. The safety record for the project, which had a high potential for accidents, was very good.

APPENDIX

TABLE 1. 1992 Wallowa Valley western spruce budworm suppression project analysis unit treatment information.

Analysis Unit	*Number Spray Blocks*	*Acres Sprayed*
Kuhn-Chesnimnus	60	43,486
Morgan Butte	50	26,736
TOTAL	110	70,222

TABLE 2. 1992 western spruce budworm population densities for Wallowa Valley analysis units.

LARVAE PER 45cm. BRANCH (Mean and SE)*

ANALYSIS UNIT	PRE-TREATMENT		POST-TREATMENT	
	Lower Crown	Mid Crown**	Lower Crown	Mid Crown**
KUHN	13.8 + 0.86	9.7	1.4 + **0.28**	1.3
MORGAN	**10.6** + 1.88	7.6	0.7 + 0.14	0.8

* Standard Errors (SE) could not be reported for converted midcrown means.

** Budworms per 45cm midcrown branch tip converted from lower crown sample using the equation Y = 0.3513 + 0.6781X (Torgerson et al. 1991).

TABLE 3. Budget for the 1992 Wallowa Valley western spruce budworm suppression project.

Salaries and Per Diem	$ 118,668
Application Contract	981,002
Supplies and Equipment	8,489
Forest Overhead	20,600
Vehicles (includes fuel and claims)	34,058
TOTAL	$1,162,817

Figure 1

VICINITY MAP
1992 ENTERPRISE WESTERN SPRUCE BUDWORM
SUPPRESSION PROJECT ANALYSIS UNITS

- Incident Commander (S.Howes)
  - Information: S.Howes
  - Safety: N.Lunde
  - Operations (S.Summers)
    - Dispatch (J.Both)
    - Cartography (D.Little)
      - N.Johnson
      - P.Fahey
    - Application Team Leaders (A.McCauley) (M.Cherry) (S.Christman)
    - Lead Observer (J.Smith)
      - Aerial Observer (J.Smith)
        - Weather/Spray Obs. (H.Sievers) (H.Allen)
      - Aerial Observer (R.Libby)
        - Weather/Spray Obs. (B.Diskin) (P.Wheeler) (E.Weaver)
      - Aerial Observer (B.Wicks)
        - Weather/Spray Obs. (M.Piazza) (N.Lunde)
  - Entomology (D.Wallesz)
    - Field Crew Leader (B.Pinto)
      - Bio Aide, P.Wheeler
    - Field Crew Leader (S.Stelling)
      - Bio Aide, E.Weaver
    - Field Crew Leader (K.Yosemite)
  - Logistics/Supply (H.Sievers) (T.Anton) (T.White)
    - Communications (C.Erikson)
  - Administration/Finance (B.Hopkins) (N.Rudger) (L.Gould)

Figure 2
1992 WALLOWA VALLEY WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT ORGANIZATION

Figure 3: Western Spruce budworm plot densities from lower crown branch samples in the Kuhn-Chesnimnus analysis unit.

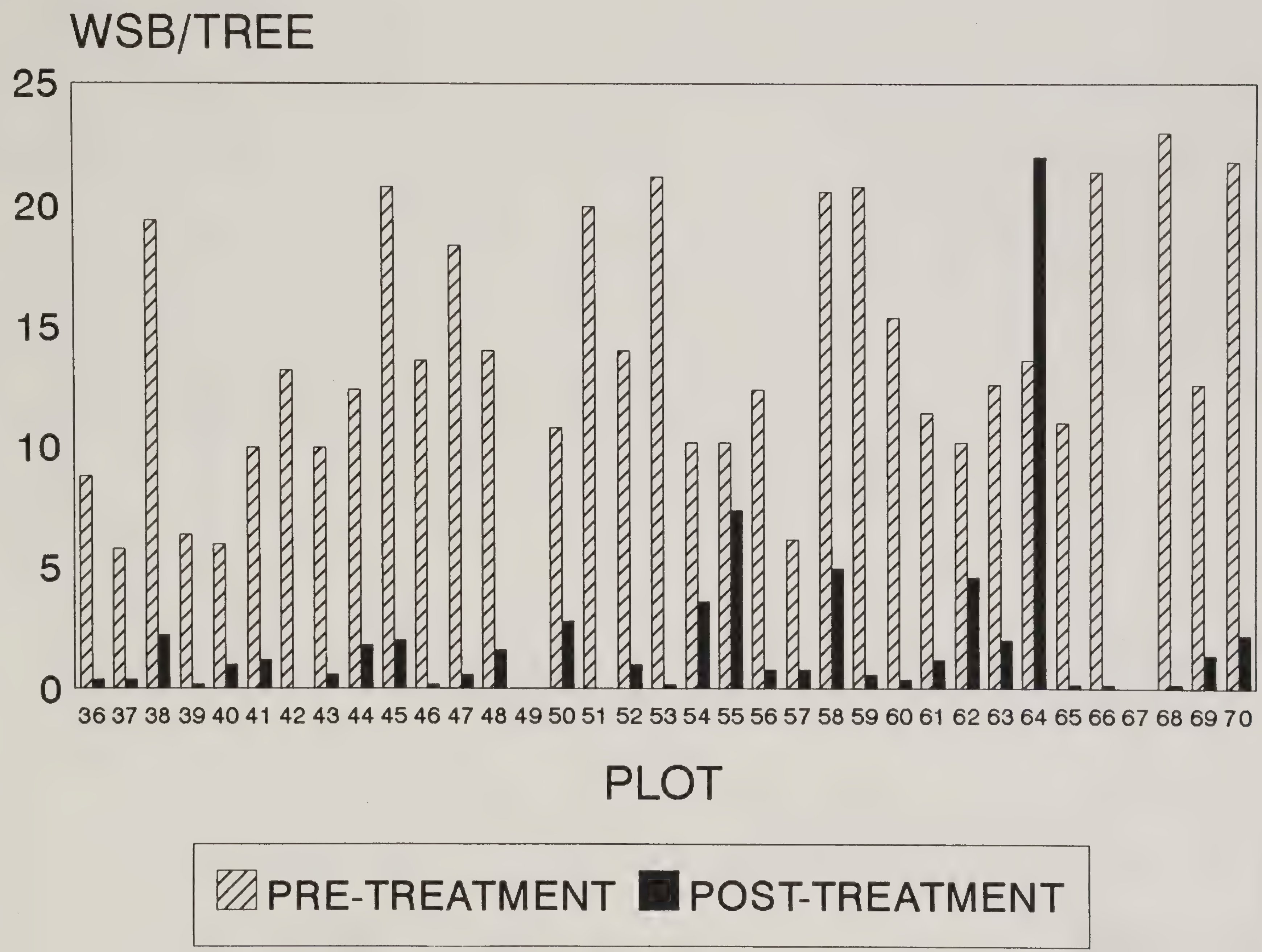

Figure 4: Western Spruce budworm plot densities from lower crown branch samples in the Morgan analysis unit.